THE VALUE *of* URBAN TREES

When we think of a forest, most of us usually think of natural, thick stands of mature trees. There are, however, many kinds of forests. One kind of forest that we often neglect to appreciate is the diverse array of trees growing in a city in parks and on streets. These urban forests provide fundamental benefits to urban environments, enhancing local environments. Trees reduce air pollution by trapping particulates and absorbing gases such as ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide.

They reduce storm water runoff and soil erosion by filtering and absorbing water. Urban environments are cooled by trees shading streets and releasing water vapor into the air. Trees reduce noise pollution by providing sound screens. They also provide habitat for wildlife that would otherwise have a difficult time surviving in urban areas. Trees provide us with a sense of well being amidst the hectic lifestyle that accompanies urban settings.

The parks managed by the National Park Service, National Capital Region within the city of Washington, D.C. play a significant role in sustaining the visual and environmental quality of the nation's capital. For example, two parks—the National Mall and Memorial Parks and the President's Park, which surrounds the White House—maintain

over 16,000 trees. Besides their environmental contributions, sustaining these trees is important because many trees, such as the American elms (*Ulmus americana*) of the National Mall and the delicate Japanese cherry trees (*Prunus* species) that surround the Tidal Basin, have cultural significance and are major assets of Washington, D.C.

Developing management strategies designed to protect and enhance urban trees and education strategies to make the public aware of the need for wise management, depend upon understanding and quantifying the resource values of the urban forest. In 2004, the National Capital Region partnered with the U.S. Forest Service, the Casey Trees Endowment, and the University of Maryland,

Cooling Effects of Trees

Trees can have many energy-saving benefits for buildings by providing shade and evaporative cooling, which reduces energy costs in the summer. They can also block winter winds, reducing heating costs in the winter. The UFORE model estimates that trees in Washington D.C. reduce building energy costs by $2.6 million each year; these are savings to residents in heating and cooling costs. In addition, lower energy use reduces the carbon emissions from power plants for an annual $96,000 savings through decreased use of fossil fuels.

In addition to reducing storm water runoff, trees have a significant cooling effect.

Urban Forestry Program (a member of the Chesapeake Watershed Cooperative Ecosystem Studies Unit) to assess the urban forest of Washington, D.C. The purpose of this study was to provide resource managers, city planners, urban foresters, and the public with baseline information on species diversity, tree size and condition, and the ecological services provided by the urban trees.

Field crews composed of trained seasonal rangers, university interns, and volunteers collected information about the urban forest during the summer of 2004. Teams collected data from 201 field plots throughout the District of Columbia, which included a mix of woodlands, city parks, National Parks and other federal installations, developed urban sites, commercial property, and residential yards. Each circular field plot was one-tenth of an acre (0.04 ha) in size, and crews inventoried all vegetation within the plot. They identified trees and took measurements such as diameters at breast height, tree heights, and crown volumes and condition. Crews collected site information data such as existing land use and ground and tree cover.

U.S. Forest Service researchers also used local hourly air pollution concentrations and meteorological data for the year 2000 in conjunction with the field data. They analyzed all the data using the Urban Forest Effects (UFORE) computer model, which quantifies ecological services, forest

structure, and capital asset value (Nowak et al. 2006). A unique outcome of the UFORE model is that the capital value of the urban forest can be expressed in dollar amount in terms of their replacement costs and the ecological services they provide, including their contribution to pollution removal, carbon sequestration, and energy savings.

Trees: A Valuable Resource

Within Washington, D.C. are an estimated 1,928,000 trees with an overall tree canopy cover of 28.6%. Slightly over half of those trees (56.3%) are less than 6 inches (15.2 cm) in diameter at breast height. The most common tree species are American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), boxelder (*Acer negundo*), tulip tree (*Liriodendron tulipifera*), and flowering dogwood (*Cornus florida*).

Our urban forest appears to be in good standing: Washington, D.C. ranks fifth in total number of trees when comparing tree coverage among seven cities in the Northeast (Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Brooklyn and New York City, New York; Jersey City, New Jersey; and Philadelphia, Pennsylvania). It places third in tree densities (49 trees/acres (121 trees/ha)) following Baltimore with 51 trees/acre (126 trees/ha) and Atlanta with 112 trees/acre (276 trees/ha). One major contributor to the urban forest is Rock Creek Park, a National Capital Region unit located in the middle of the city. Rock Creek Park occupies approximately 7% (2,876 acres (1,164 ha))

of Washington, D.C. and contains large areas of uncultivated, dense forest. Other National Park units are also significant components of Washington, D.C.'s urban forest.

Although many environmental and social benefits remain to be quantified, the UFORE model has allowed us to calculate several benefits of the urban forest in our nation's capital. The benefits are very significant. As an example, poor air quality is a common problem in cities and leads to human health problems, damage to structures, reduced visibility, and alteration of ecosystem

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American elms are a distinctive feature of the National Mall's landscape.
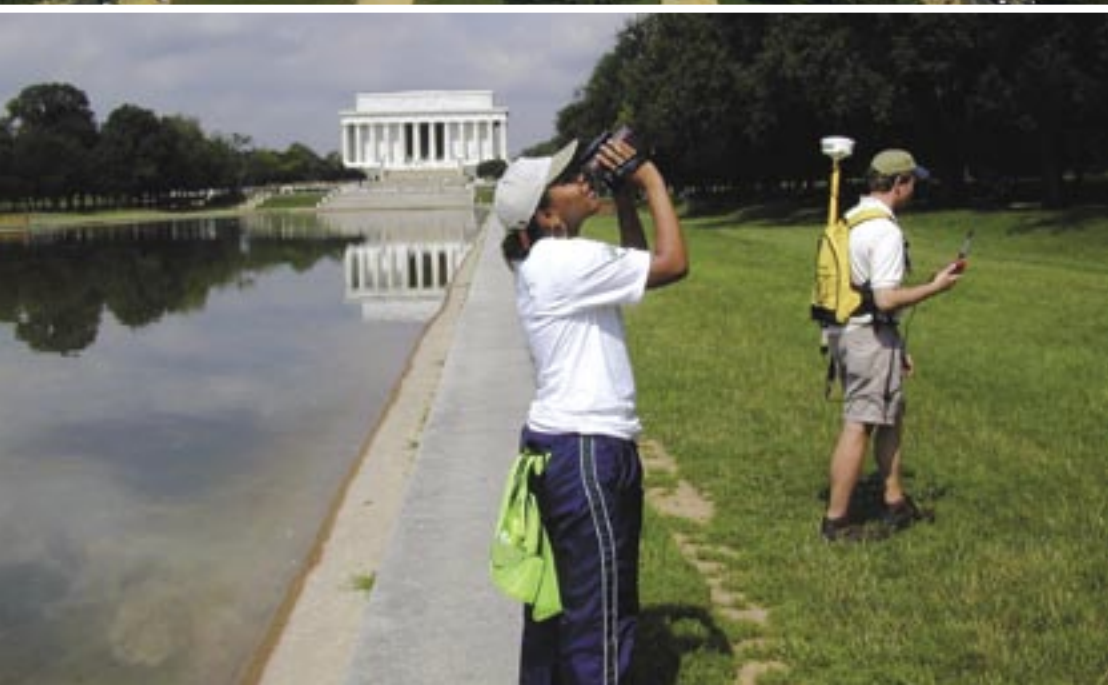
Top: The National Mall in Washington, D.C. houses a large population of trees.

Bottom: Forestry interns measuring tree height (left) and gathering GPS information (right).

" The urban forest can help improve air quality by removing pollutants from the air and reducing air temperature. Yearly pollution removal by trees in Washington, D.C. was estimated at 492 tons, an ecological service with an associated value of $2.5 million. "

processes. The urban forest can help improve air quality by removing pollutants from the air and reducing air temperature. Yearly pollution removal by trees in Washington, D.C. was estimated at 492 tons, an ecological service with an associated value of $2.5 million. The ecological services that the Washington, D.C. urban forest provides amount to more than 523,000 tons of carbon storage, a value estimated at approximately $9.6 million. Carbon stored in trees and other plants can help mitigate atmospheric effects of carbon dioxide released into the environment by motor vehicles. Thus, urban trees can actually help mitigate climate change by storing atmospheric carbon and

turning it into new tree growth each year. The UFORE model determined that the difference in carbon storage abilities of the trees between different years (or carbon sequestration) is 16 tons per year, worth an annual value of $297,000. Across the city, the urban forest provides savings in annual building energy use equal to $2,616,000, according to the UFORE modeling results.

Urban forests have a structural replacement value based on the tree itself, which is the cost of replacing the tree with a similar tree or compensating for its loss. The value is based on the location of the tree, the species, size, and condition. Structural values tend to increase with an increase in the number of healthy trees and as the trees grow larger. The UFORE study estimated that the structural value of the trees in Washington, D.C. is approximately $3.5 billion. Clearly, these ecological and compensatory values show the significant capital asset of urban trees.

Looking into the Future

Because of the relatively harsh conditions of the urban environment in Washington, D.C., these trees require special attention and exceptional care to ensure successful growth and maintenance. City environments differ greatly from natural habitats. The health and survivorship of trees in a city are most affected by air pollution, poor soil quality, and physical damage. In many cases when trees are stressed, they become more susceptible to infestation by insect pests and diseases.
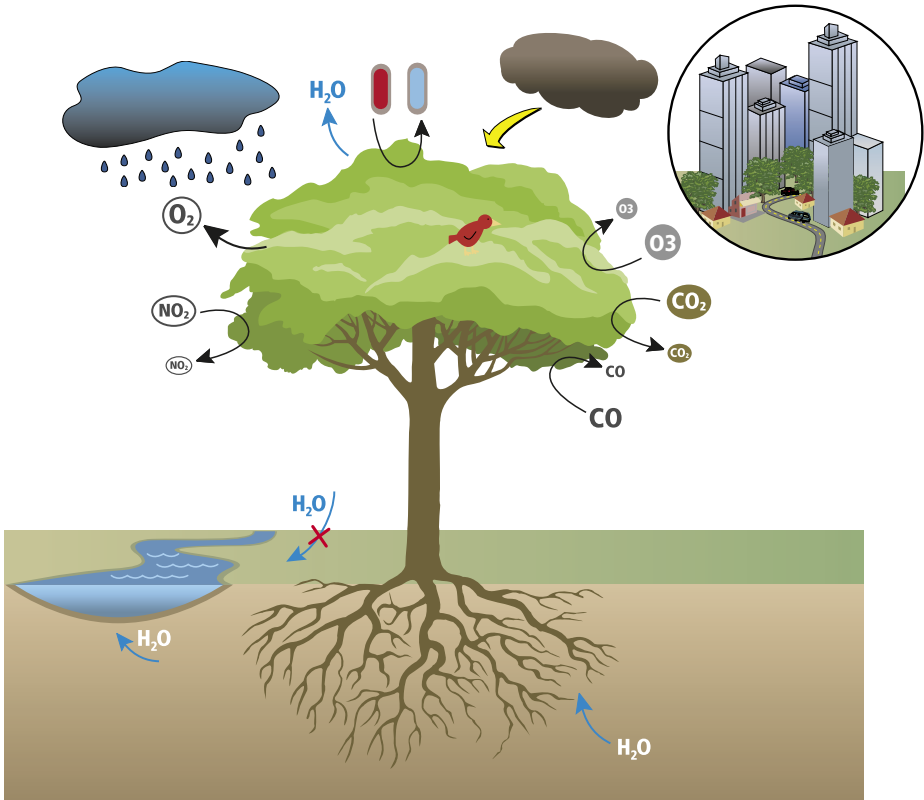
In order to track changes in the urban forest over time, field crews will reassess 10% of the Park trees every year to detect overall changes and trends. This means that every 10 years the Parks will complete a new inventory. The information will facilitate planning efforts directed at maintaining and increasing the number of healthy trees.

Although the National Capital Region is quick to replace street and park trees that have died, we also recognize the importance of sustaining large, healthy trees to further improve the area's air quality. Researchers have found that healthy trees greater than or equal to 30 inches (76 cm) in diameter remove 70 times more pollution per year than healthy trees that are less than or equal to 3 inches (7.6 cm) in diameter. This fact should persuade all municipalities to take greater interest in sustaining their older trees.

" The UFORE study estimated that the structural value of the trees in Washington, D.C. is approximately $3.5 billion. "

The urban forest improves air quality by reducing air temperature and removing pollutants. Images are from air quality webcam at the Netherlands Carillon.

March 2005

June 2005

September 2005

December 2005

Right: Street trees are part of the urban forest in Washington, D.C.

Using the baseline data collected in a comprehensive inventory of all their trees, resource managers at the National Mall and Memorial Parks are developing a maintenance-based data collection tool and GIS program to better address management needs. Future data applications will include identifying where trees are missing in accordance with site planting plans, tracking diseases throughout the Park, identifying survivorship of tree species in different areas, creating a historic tree preservation plan, and directing maintenance efforts. Managers will continually update this database with information about new tree plantings, removals, and causes of removal.

References

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Nowak, D. J., R. E. Hoehn, D. E. Crane, J. C. Stevens, and J. T. Walton. 2006. Assessing Urban Forest Effects and Values. Washinton, D.C.'s Urban Forest. USDA Forest Service General Technical Report. Northeastern Research Station, Syracuse, New York. (In Press)

Ecological Benefits of Urban Trees

Urban forests provide many benefits to society. Trees 🌳 in cities improve air quality by directly removing urban pollutants 🍃 from the air such as ozone O_3, carbon monoxide CO, carbon dioxide CO_2 and nitogen dioxide NO_2. Some of these pollutants CO_2 CO are integrated to the trees' tissue as they grow. Because of their shading benefits and evapotranspiration, trees reduce air temperature ➡️ contributing to energy savings for city dwellers. They contribute to the quality of a watershed by reducing storm water runoff ✛ with the consequence of reduced erosion ✛ and reduced transportation of sediments and pollutants to streams. Trees also provide habitat for urban wildlife 🐦.

CENTER FOR URBAN ECOLOGY

Horticultural Landscape Program The Horticultural Landscape Program provides technical assistance to the parks of the National Capital Region in the design, development, and maintenance of horticultural landscapes. Assistance is provided in the diagnosis of plant disorders, selection of plant material, and the design of sustainable planting environments. The Program collaborates closely with the Integrated Pest Management, Exotic Plant Management Team, and Soils and Geology Programs. We engage in studies to protect and describe the urban forest by participating in city-wide efforts such as Dutch elm disease (*Ophiostoma ulmi*) and gypsy moth (*Lymantria dispar*) management and in surveys describing the extent, health, and ecological values of the urban forest. The Horticultural Landscape Program collaborates with the District of Columbia's Urban Forestry Administration, the Casey Trees Endowment, and other groups interested in sustaining the urban forest of the National Capital Region and the Washington, D.C. metropolitan area.